Uitgegeven den
11 JAN 1948

PATENT SPECIFICATION

595,346
No. 5952/41.

Application Date: May 7, 1941.

Complete Specification Left: May 7, 1942.

Complete Specification Accepted: Dec. 3, 1947.

PROVISIONAL SPECIFICATION

Improvements relating to Bearings of Internal Combustion Gas Turbines, Turbine Type Gas Compressors, and like High Speed Machinery

We, HAYNE CONSTANT, of Royal Aircraft Establishment, South Farnborough, in the County of Hants, DAVID MACLEISH SMITH, of 37, Church Street, Stretford, Manchester, in the County of Lancaster, FRANCIS EDGAR BAUMANN, of "Lacey Oaks", Styal Road, Wilmslow, in the County of Chester, all Subjects of the King of Great Britain, and METROPOLITAN-VICKERS ELECTRICAL COMPANY LIMITED, of Number One, Kingsway, London, W.C.2, a British Company, do hereby declare the nature of this invention to be as follows:—

This invention relates to internal combustion gas turbines, turbine type gas compressors and like high speed machinery wherein the bearings are required to be cooled artificially, as is notably the case in plant which is required to have a high power/weight ratio or occupy a small volumetric space and/or is required to offer a minimum of head resistance, these requirements arising, for example, where the plant is used for the propulsion of aircraft. It is advantageous in such plant to employ ball bearings. The general arrangement becomes so compact and interiorly congested that difficulties arise in maintaining these bearings cool. For example, in such plant the inner ball race which is frequently carried on the rotating part, may be separated by only a short length or path of metal member from parts which run at relatively high temperature such as the rotor drum or cylinder of a gas turbine or its compressor, whilst the stationary ball race may be similarly carried with the interposition of a relatively short length or path of metal member, from a part of the structure running at relatively high temperature, such as the internal combustion chamber or the stationary member of a gas turbine or air compressor supplying the combustion chamber.

According to the present invention the bearing is enclosed in a substantially fluid-tight housing provided with inlet and outlet pipes by which a cooling fluid, preferably air at moderate pressure along with lubricating oil in the form of mist, is passed to, through and from said housing. This cool air is conveniently taken from an intermediate stage of the turbine type compressor of the plant, being passed therefrom through a cooler if necessary.

According to an important subsidiary feature of the invention the aforesaid bearing housing is surrounded at least in part by a liquid-tight chamber provided with inlet and outlet pipes by which a cooling liquid such as water or oil can be circulated through the chamber. Said chamber may be provided by one or more resilient substantially cylindrical members.

Where necessary in the plant, labyrinth glands or packings of *per se* well known type may be provided for the sealing of the relatively rotatable parts of the bearing housing and also for the prevention of access of hot air or gases to the bearing housing from parts of the plant adjacent said housing. Such labyrinth gland may be arranged with an intermediate point or chamber with an exhaust to atmosphere to ensure the desired distribution of cooling air flow and hot gas flow, that is, to permit entrance of the cooling air to the bearing housing and prevent the entrance of hot air or gases thereto. Alternatively air may be introduced at this intermediate point, or additionally at some other intermediate point, at such a pressure that there will be a slight flow or air in both directions therefrom.

The inner and/or outer ball races of the bearing may be carried on auxiliary resilient cylinders which may be spaced from the shaft or equivalent member and from the bearing housing so as to provide spaces and cooling fluid may be passed through these spaces which thus become jacket space, and this may be formed such as by grooving one of the walls thereof so as to cause the cooling

[Price 1/-]

fluid to take a helical or tortuous path within the jacket space.

The pipes for the cooling fluids may be arranged in accordance with co-pending Applications Nos. 5951 of 1941 (which is Letters Patent No. 582,082) and 5953 of 1941 (Serial No. 595,347).

Dated the 6th day of May, 1941.

A. S. CACHEMAILLE,
Chartered Patent Agent,
Number One, Kingsway, London, W.C.2.
Agent for the Applicants.

COMPLETE SPECIFICATION

Improvements relating to Bearings of Internal Combustion Gas Turbines, Turbine Type Gas Compressors, and like High Speed Machinery

We, HAYNE CONSTANT, of Royal Aircraft Establishment, South Farnborough, in the County of Hants, DAVID MACLEISH SMITH, of 37, Church Street, Stretford, Manchester, in the County of Lancaster, FRANCIS EDGAR BAUMANN, of "Lacey Oaks", Styal Road, Wilmslow, in the County of Chester, all Subjects of the King of Great Britain, and METROPOLITAN-VICKERS ELECTRICAL COMPANY LIMITED, of Number One, Kingsway, London, W.C.2, a British Company, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

This invention relates to internal combustion turbines, turbine type gas compressors and like high speed machinery wherein the bearings are required to be cooled artificially, as is notably the case in plant which is required to have a high power/weight ratio or occupy a small volumetric space and/or is required to offer a minimum of head resistance, these requirements arising, for example, where the plant is used for the propulsion of aircraft. It is advantageous in such plant to employ ball and/or roller bearings. The general arrangement becomes so compact and interiorly congested that difficulties arise in maintaining these bearings cool. For example, in such plant the inner ball race, which is frequently carried on the rotating part, may be separated by only a short length or path of metal member from parts which run at relatively high temperature, such as the rotor drum or cylinder of a gas turbine or its compressor, whilst the stationary ball race may be similarly carried with the interposition of a relatively short length or path of metal member, from a part of the structure running at relatively high temperature, such as the internal combustion chamber or the stationary member of a gas turbine or air compressor supplying the combustion chamber.

According to the present invention the ball or roller bearing is enclosed in a housing which is constructed to be substantially proof against entry of gas from either side at which the gas pressure may exceed that within the housing, which is provided with means such as inlet and outlet pipes whereby a cooling and/or lubricating fluid such as air or gas laden with oil mist can be caused to flow through the housing. The cool air is conveniently taken from an intermediate stage of the turbine type compressor of the plant, being passed therefrom through a cooler if necessary.

According to an important subsidiary feature of the invention the aforesaid bearing housing is surrounded, at least in part, by a liquid-tight chamber provided with inlet and outlet pipes by which a cooling liquid such as water or oil can be circulated through the chamber.

Where necessary in the plant, labyrinth glands or packings of *per se* well known type may be provided for the sealing of the relatively rotatable parts of the bearing housing and also for the prevention of access of hot air or gases to the bearing housing from parts of the plant adjacent said housing. Such labyrinth gland may be arranged with an intermediate point or chamber with an exhaust passage to atmosphere or to a region in which the pressure is suitably lower than in the chamber to ensure the desired distribution of cooling air flow and hot gas flow, that is, to permit entrance of the cooling air to the bearing housing and prevent the entrance of hot air or gases thereto. Alternatively air may be introduced at this intermediate point, or additionally at some other intermediate point, at such a pressure that there will be a slight flow of air in both directions therefrom.

The pipes for the cooling fluids may be arranged in accordance with copending Applications for Letters Patent Nos. 5951 of 1941 (Letters Patent No. 582,082) and 5953 of 1941 (Serial No. 595,347).

The single figure of the accompanying drawing is a somewhat diagrammatic sectional elevation showing a bearing for the shaft of a rotor drum or cylinder of,

for example, a turbine the blading of which is in an annular passage supplied from a combustion chamber which may also be of annular form surrounding the shaft and carrying within it the fixed member of the shaft bearing which is provided with a housing and chamber in accordance with the invention.

A small part of the drum of the turbine is indicated at 1, and at 2 is shown a part of the first row or stage of blading carried by the drum 1. At 3 is shown a part of a blade in the succeeding row of fixed blading carried by a stator casing (not shown). The direction of gas flow is indicated by the arrow 4. At 5 is indicated a part of the inner wall of the discharge passage from the annular internal combustion chamber (not shown), and at 6 is shown part of fixed guide blading or a radially supporting web uniting the left-hand end of the passage wall 5 with the exterior casing of the machine. The rotor cylinder 1 is welded as indicated at 7 to a "swan-neek" member or disc 8 which is shown integral with the hollow shaft 9 whereon is carried, by means not *per se* shown, the inner race 10 of the ball bearing. The outer race 11 of this bearing is carried by a sleeve member 12 having at the right-hand end an external flange 13. The sleeve member 12 is reduced in diameter at 14 and is integral with or connected to a sleeve portion 15 which surrounds the left-hand end of the shaft 9 with relatively small clearance, whilst three sets 16, 17 and 18 of *per se* well known labyrinth packing are provided.

The flange 13 of the sleeve member 12 is welded as indicated at 19 to the right-hand end of an outer sleeve 20, the left-hand end of which has an internal flange welded, as indicated at 21, to the left-hand end 15 of the bearing sleeve 12. The left-hand end of the sleeve 20 is secured by bolting, as indicated at 22, to an internal flange on the left-hand end of a "swan-neck" member 23. The member 23 provides flexibility. The outermost portion of the member 23 is secured by bolting its flange 24 to an internal flange provided on the wall member 5, as indicated at 25. The outer race of the ball bearing is thus supported from the wall member 5.

An annular cover member 26 is secured to the right-hand end of the sleeve member 12 which, along with its portion 14 and with the member 26 provides the housing for the bearing, in accordance with the invention. The member 26 is provided with a flange 27 having a small clearance with a lid 28 on the shaft 9. The gap between the parts 27 and 28 may be rendered more fluid-tight by the provision of labyrinth packing if desired.

At 29 is shown a pipe arranged above the shaft in the diagram and passing through the flange 13 of the sleeve 12 to an orifice 30 in the latter to convey air and oil mist into the aforesaid bearing housing. Beneath the shaft 9 the member 26 is provided with an orifice 31, with which is united a drain pipe 32 for the air and oil from the bearing housing and leading if desired to a place at atmospheric pressure.

The flanged sleeve member 20 provides between itself and the sleeve 12, 13, 14, 15 the space 33 to which cooling water or oil may be conveyed and carried off by respective pipes indicated at 34 and 35, the left-hand ends of which pipes are secured to orifices in the flange 13 of the sleeve 12, one of these orifices not being visible in the drawing but being circumferentially spaced from other orifices in the flange 13, as will hereinafter become apparent.

One purpose of the set of labyrinth packing 16, 17, 18 is to prevent any hot gas from finding its way through the annular gap 36 (and through labyrinth packing 37 if any) to the bearing housing. At 38 is shown a portion of a pipe which connects with a perforation in the left-hand end 15 of the sleeve 12 to connect with a space 39 between the sets 16 and 17 of packing. The pipe 38 passes through a perforation in the flange 13 of the sleeve 12 and is thereafter connected in a manner not shown to a source of cooling air, the air flowing axially in both directions through sets of packing 16 and 17. At 40 is shown a pipe leading from the space 41 between the sets of packing 17 and 18 to a region in which the pressure is lower than in the enclosure 8, 12, 26, for instance to atmosphere. The pipe 40 also passes through a hole in the flange 13. Air or gas flowing axially through the packing 17 and 18 can thus pass to atmosphere.

Whilst in the drawing the particular location of the bearing within the wall member 5 and the particular coaxial member 23 necessitates the various fluid pipes leaving the bearing housing and cooling chamber 33 in the longitudinal direction, it will be appreciated that in other situations pipes may lead away from said housing and chamber radially, such as in the manner described in the Specification of Letters Patent No. 582,082 aforesaid, and, furthermore, such radial pipes may be carried between the tubular portions of the multi-pipe gas connector described in the Specification of Application for Letters Patent No.

5953 (Serial No. 595,347) of even date herewith.

Having now particularly described and ascertained the nature of our said invention and in what manner the same is to be performed, we declare that what we claim is:—

1. In an internal combustion turbine or compressor or like high speed machine or part thereof, a housing for a ball or roller bearing constructed to be substantially proof against entry of gas from ether side at which the gas pressure may exceed that within the housing, and having means whereby cooling and lubrication can be effected by the passage either side at which the gas pressure may mist.

2. In an internal combustion gas turbine or compressor or like high speed machine or part thereof, a bearing housing as claimed in claim 1 and surrounded at least in part by a liquid-tight chamber provided with inlet and outlet pipes by which a cooling liquid can be circulated through said chamber.

3. In an internal combustion gas turbine or compressor or like high speed machine or part thereof, a bearing housing as claimed in claim 1 or claim 2, having associated with parts of it labyrinth packing arranged for the prevention of access of hot air or gases to the bearing housing through relatively rotating portions thereof.

4. In an internal combustion gas turbine or compressor or like high speed machine or part thereof, a bearing housing as claimed in claim 3, wherein the labyrinth packing is arranged with an intermediate point or chamber, connected by a passage leading outside the bearing housing and either exhausting to a region in which the pressure is less than that in the bearing, or adapted to receive cooling air or gas at a pressure exceeding that in the adjacent region outside the housing.

5. In an internal combustion gas turbine or compressor or like high speed machine or part thereof, a bearing housing as claimed in claim 4, wherein the labyrinth packing is arranged with two intermediate points or chambers, each connected by a passage leading outside the bearing housing, one passage exhausting to atmosphere and the other adapted to receive cooling air or gas.

6. In an internal combustion gas turbine or compressor or like high speed machine or part thereof, a bearing housing as claimed in the preceding claims and substantially as illustrated in the accompanying drawing and substantially as described with reference thereto.

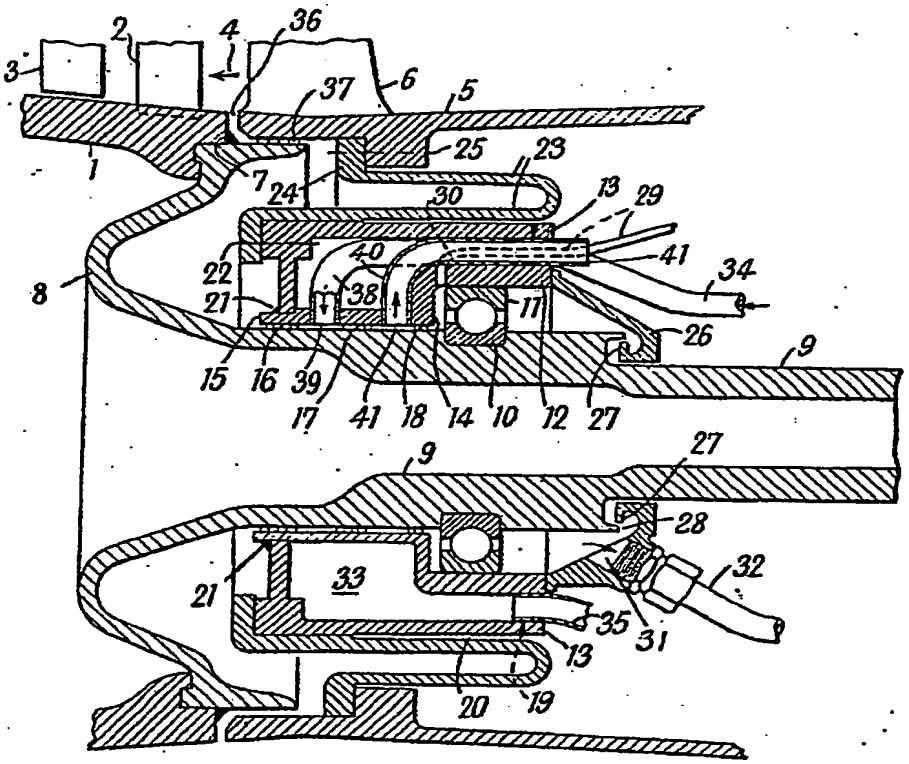
Dated the 6th day of May, 1942.

A. S. CACHEMAILLE,
Chartered Patent Agent,
Number One, Kingsway, London, W.C.2.
Agent for the Applicants.

Leamington Spa: Printed for His Majesty's Stationery Office, by the Courier Press.—1948.
Published at The Patent Office, 25, Southampton Buildings, London, W.C.2, from which copies, price 1s. 0d. each (inland) 1s. 1d. (abroad) may be obtained.

595,346 COMPLETE SPECIFICATION

1 SHEET



[This Drawing is a reproduction of the Original on a reduced scale.]

H.M.S.O.(Ty.P.)